REMARKS

Status of the Claims

By this amendment, claims 1, 4-7, 9-15, 17-19, 24, 26-27, 29-36, 39-42, 44-49, and 51-54 are pending in the application. Claims 16, 20-23, 25, 43 and 50 are being canceled. Claims 1, 7, 9, 19, 24, 26, 35, 41, 45, 47 and 51 are being amended. The claim amendments are supported by the specification and original claims, and no new matter is being added. Thus, entry of the amendments and reconsideration of the present case is requested.

Allowed Claims

Applicants appreciate the Examiner's indication of allowance of claims 1, 4-6, 27-36, 39 and 40, and the Examiner's indication that claims 16, 45 and 50 would be allowable if re-written in independent form and including all of the limitations of their base claims.

Objection to Claim 1

The Examiner objected to claim 1 because the first two steps were referred to as step (a). This informality has been corrected.

Rejection Under 35 U.S.C. 112, second paragraph, of claim 9

The Examiner rejected claim 9 under 35 U.S.C. 112, second paragraph for providing insufficient antecendent basis for the limitation "a method according to claim 8."

The claim has been amended to recite "a method according to claim 7" and is now believed to be allowable under 35 U.S.C. 112, second paragraph.

Rejection Under 35 U.S.C. 102 of Claims 7, 9-15, 17-26, 41-44, 47-49, and 51-54

The Examiner rejected claims 7, 9, 12-15, 17-26, 51 and 53-54 under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,180,464 to Tatsumi et al. This rejection is traversed.

The Examiner indicated that objected to claim 16 would be allowable if rewritten in independent form and including all of the limitations of its base claim. Accordingly, its base claim, claim 7, has been amended to recite all of the limitations of objected to claim 16. As amended, claim 7 now recites "electrostatically holding the substrate comprising the metal silicide and polysilicon containing layers on an electrostatic chuck in the chamber ... [and] providing an energized second cleaning gas comprising an electronegative plasma in the chamber, the energized second cleaning gas being different from the first cleaning gas." Thus, claim 7 and the claims depending therefrom are believed to allowable over Tatsumi et al.

Claim 19 is not anticipated by Tatsumi et al because Tatsumi et al does not teach a method of etching a substrate and cleaning surfaces comprising, after etching first and second materials on the substrate, "providing a cleaning gas comprising an oxygen containing gas in the chamber and coupling RF power to energize the cleaning gas to clean the first and second etchant residue deposits," as recited in the claim. Instead, Tatsumi et al teaches an oxygen plasma treatment performed after an etching step, in which "microwave discharge was carried out ... by way of performing the oxygen plasma treatment" (column 8, lines 53-57.) In other words, Tatsumi teaches a step of providing an oxygen containing gas and energizing the gas via microwave power after etching a substrate, but does not teach providing a cleaning gas comprising an oxygen containing gas

and energizing the gas via RF power, as recited in the claim. Thus, Tatsumi et al fails to teach the method recited in claim 19, and claim 19 and the claims depending therefrom are not anticipated by Tatsumi et al.

Claim 19 is furthermore not obvious over the teachings of Tatsumi because, as is well understood to those of ordinary skill in the art, a gas energized by coupling RF power does not have the same properties and effects as a gas that is energized through the coupling of microwave power. In a gas energized by RF power, coupling of energy from the oscillating RF electromagnetic field to the energized gas results in both energized ions and electrons that participate in the chamber process. In a microwave energized gas, on the other hand, the more rapidly oscillating microwave electromagnetic field couples less energy to the ions, yielding a "softer" process that is more dependent upon the interactions of the excited electrons. Accordingly, the action of a "harsher" RF energized gas process having more highly energized ions cannot be inferred from a teaching of a "softer" microwave energized gas. Thus, claim 19 and the claims depending therefrom are not obvious over the teachings of Tatsumi et al.

Claim 51 is not anticipated by Tatsumi et al because Tatsumi et al does not teach "(a) supporting the substrate in the chamber, the substrate having a first and a second layer thereon, the second layer comprising a metal silicide layer; ... (b) providing a first energized gas in the chamber to etch the first layer; ... [and] (c) providing a second energized gas in the chamber to etch the second layer and at least partially remove the etchant residue formed on the surfaces in the chamber in (b)," as recited in the claim. Instead, Tatsumi et al teaches etching a polycide layer comprising a tungsten silicide layer overlying a DOPOS layer (column 6, lines 60-64) by providing an etchant gas comprising, for example, SF_6 and HBr. Thus, Tatsumi et al teaches the etching of a first layer comprising tungsten silicide followed by the etching of a second layer comprising a second material, but does not teach the etching of a first layer followed by the etching of a second layer comprising metal silicide. Accordingly, claim 51 and the claims depending therefrom

are not anticipated by Tatsumi et al.

The Examiner rejected claims 7, 9-15, 19-26, 47-49 and 51 under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,354,417 to Cheung et al. This rejection is traversed.

As discussed above, claim 7 has been amended to incorporate all of the limitations of objected to claim 16. Thus claim 7 and the claims depending therefrom are believed to be allowable over Cheung et al.

Claim 19 is not anticipated by Cheung et al because Cheung et al does not teach "(b) providing an energized first gas in the chamber, the energized first gas being capable of etching a first material on the substrate thereby depositing a first etchant residue on the surfaces in the chamber ... (c) after (b), providing an energized second gas comprising a fluorinated cleaning gas in the chamber, the energized second gas being capable of etching a second material on the substrate while suppressing deposition of a second etchant residue onto the first etchant residue, the first etchant residue being compositionally different from the second etchant residue ... [and] (d) after (c), providing a cleaning gas comprising an oxygen containing gas in the chamber and coupling RF power to energize the cleaning gas to clean the first and second etchant residue deposits formed on the surfaces in the chamber," as recited in the claim.

Cheung et al teaches a main etch step in which SF_6, HBr and O_2 are provided to etch a $MoSi_x$ layer and an overetch step performed after the main etch step to etch an underlying polysilicon layer, where either HBr or a combination of HBr, Cl_2 and a He and O_2 mixture are provided, followed by a stripping step with O_2 (Table III, column 8, line12 through column 9, line 23.) In other words, Cheung et al teaches a step of providing a first gas to etch a first material, followed by a step of providing a second gas to etch a second material, but Cheung et al does not teach that the second gas, comprises a fluorine-

containing gas, and instead teaches that the first gas, or main etching gas, comprises the fluorine containing gas. Thus, as Cheung et al does not teach providing a second gas comprising a fluorinated cleaning gas to etch the second material, claim 19 and the claims depending therefrom are not anticipated by Cheung et al.

The Examiner indicated that objected to claim 50 would be allowable if rewritten in independent form and including all of the limitations of its base claim. Accordingly, its base claim, claim 47, has been amended to recite all of the limitations of objected to claim 50. As amended, claim 47 now recites "after (b), providing an energized gas consisting essentially of O_2 in the chamber to at least partially remove etchant residue from the surfaces in the chamber and to remove residual charge accumulated in the substrate." Thus, claim 47 and the claims depending therefrom are believed to be allowable over Cheung et al.

Claim 51 is not anticipated by Cheung et al because Cheung et al does not teach "(a) supporting the substrate in the chamber, the substrate having a first and a second layer thereon, the second layer comprising a metal silicide layer; ... (b) providing a first energized gas in the chamber to etch the first layer; ... [and] (c) providing a second energized gas in the chamber to etch the second layer and at least partially remove the etchant residue formed on the surfaces in the chamber in (b)," as recited in the claim. Instead, Cheung et al teaches a main etch step in which SF_6, HBr and O_2 are provided to etch a $MoSi_x$ layer and an overetch step performed after the main etch step to etch an underlying polysilicon layer, where either HBr or a combination of HBr, Cl_2 and a He and O_2 mixture are provided, followed by a stripping step with O_2 (Table III, column 8, line12 through column 9, line 23.) In other words, Cheung et al teaches a step of providing a first gas to etch a first layer comprising MoSix, followed by a step of providing a second gas to etch a second layer comprising polysilicon, but Cheung et al does not teach a step of providing a first gas to etch a first layer, followed by a step of providing a second gas to etch

a second layer comprising metal silicide. Accordingly, claim 51 and the claims depending therefrom are patentable over Cheung et al.

The Examiner rejected claims 41-44 under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 5,865,896 to Nowak et al. This rejection is traversed.

Claim 41 is not anticipated by Nowak et al because Nowak does not teach "setting a chamber source power level applied to the antenna to remove residue from the surfaces of the ceiling portion", as recited in the claim. Instead, Nowak teaches that "during chamber cleaning operations, RF energy is applied to the ceiling electrode ... [and] once the capacitively coupled plasma has been ignited, RF energy may be applied to the coil antenna to maintain the plasma at a higher plasma density" (column 4, lines 16-23.) Thus, Nowak et al teaches applying power to an coil to maintain a cleaning plasma at a higher plasma density, but does not teach or suggest setting a source power level that is specifically tailored to cause cleaning of the surfaces of a ceiling portion of the chamber. Nowak et al further teaches against the claim by teaching that "certain residues, such as silicon dioxide, typically have low etch rates at low ion energies, and therefore can be difficult to remove by inductively coupled plasmas" (column 2, lines 13-16.) The claimed antenna generates an inductively coupled plasma which is taught against by Nowak et al. Thus, claim 41 and the claims depending therefrom are not anticipated by Nowak et al.

The Examiner rejected claims 7, 9-12, 14-15, and 51-54 under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,164,330 to Davis et al. This rejection is traversed.

Claim 7 has been amended to incorporate all of the limitations of objected to claim 16. Thus, as discussed above, claim 7 and the claims depending therefrom are believed to be allowable over Davis et al

Claim 51 is not anticipated by Davis et al because Davis et al does not teach "(a) supporting the substrate in the chamber, the substrate having a first and a second layer thereon, the second layer comprising a metal silicide layer; (b) providing a first energized gas in the chamber to etch the first layer; ... [and] (c) providing a second energized gas in the chamber to etch the second layer and at least partially remove the etchant residue formed on the surfaces in the chamber in (b)," as recited in the claim. Instead, Davis et al teaches a process for "uniformly etching back a refractory metal film such as tungsten" (column 4, lines 28-29.) Thus, Davis et al teaches a method for etching a single layer comprising a refractory metal, but does not teach etching a first layer followed by etching of a second layer comprising a metal silicide. Accordingly, claim 51 and the claims depending therefrom are not anticipated by Davis et al.

Objected to Claims 16, 45 and 50

The Examiner rejected to dependent claims 16, 45 and 50 as "being dependent upon a rejected base claim," and indicated that the claims would be allowable if re-written in independent form and including all of the limitations of the base claim and any intervening claims.

The limitations of claim 16 have been incorporated into its base claim, claim 7, and thus claim 7 and the claims depending therefrom are believed to be allowable.

The limitations of claim 50 have been incorporated into its base claim, claim 47, and thus claim 47 and the claims depending therefrom are believed to be allowable.

Claim 41, from which objected to claim 45 depends, has been amended to overcome the 102(e) rejection over Nowak et al, as discussed above, and thus claim 41 and the claims depending therefrom are believed to be allowable.

CONCLUSION

The above-discussed amendments and remarks are believed to place the present application in condition for allowance. Should the Examiner have any questions regarding the above remarks, the Examiner is requested to telephone Applicant's representative at the number listed below.

Respectfully submitted,

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MARKED-UP CLAIMS FOR S/N: 09/362,924

1. (amended three times) A method of treating a chamber to at least partially remove residue from surfaces in the chamber, the method comprising:

(a) transferring a substrate into the chamber and electrostatically holding the substrate on an electrostatic chuck;

(b)[(a)] providing an energized first process gas comprising one or more of CF_4, SF_6 and NF_3 in the chamber to treat the surfaces in the chamber; and

(c)[(b)] providing an energized second process gas in the chamber to further treat the surfaces in the chamber and to assist in de-chucking the substrate from the electrostatic chuck, the second process gas being different than the first process gas.

7. (twice amended) A method of etching a substrate comprising a metal silicide containing layer and a polysilicon containing layer in a chamber and cleaning etchant residue formed on surfaces in the chamber, the method comprising the steps of:

(a) [placing] electrostatically holding the substrate comprising the metal silicide and polysilicon containing layers on an electrostatic chuck in the chamber;

(b) in a first stage, providing an energized first process gas in the chamber to etch through the metal silicide containing layer, the first process gas comprising a substrate etching gas and a first cleaning gas comprising a fluorinated gas;

(c) in a second stage conducted after (b), providing a second energized process gas in the chamber to etch through the polysilicon containing layer; and

(d) in a third stage conducted after (c), providing an energized second cleaning gas comprising an electronegative plasma in the chamber, the energized second cleaning gas being [that is] different from the first cleaning gas.

9. (amended) A method according to claim [8] 7 wherein the fluorinated gas comprises one or more of CF_4, SF_6 and NF_3.

19. (twice amended) A method of etching a substrate in a chamber and cleaning etchant residue from surfaces in the chamber, the method comprising the steps of:

(a) placing the substrate in the chamber;

(b) providing an energized first gas in the chamber, the energized first gas being capable of etching a first material on the substrate thereby depositing a first etchant residue on the surfaces in the chamber;

(c) after (b), providing an energized second gas comprising a fluorinated cleaning gas in the chamber, the energized second gas being capable of etching a second material on the substrate while suppressing deposition of a second etchant residue onto the first etchant residue, the first etchant residue being compositionally different from the second etchant residue; and

(d) after (c), providing a cleaning gas comprising an oxygen containing gas in the chamber and coupling RF power to energize the cleaning gas to clean the first and second etchant residue deposits formed on the surfaces in the chamber.

24. (twice amended) A method according to claim [23] 19 wherein the fluorinated cleaning gas comprises one or more of CF_4, SF_6 and NF_3.

26. (amended) A method according to claim [25] 19 wherein the oxygen containing gas consists essentially of oxygen.

35. (twice amended) A method of etching a substrate in a chamber and cleaning residue that forms on surfaces in the chamber, the method comprising the steps of:

(a) placing the substrate in the chamber and [electrostically] electrostatically holding the substrate on an electrostatic chuck;

(b) in an etching stage, etching one or more materials on the substrate using energized gas, at least one composition of the energized gas including an etching gas comprising one or more of Cl_2, N_2, O_2, HBr and He-O_2; and a residue cleaning gas comprising one or more of CF_4, SF_6 and NF_3; and

(c) cleaning the residue formed on the surfaces in the chamber and assisting in dechucking the substrate from the electrostatic chuck using another energized gas comprising oxygen.

41. (twice amended) A method of cleaning a chamber to remove residue from surfaces of a ceiling portion in the chamber, the chamber having an antenna adjacent to the ceiling portion [about the chamber], and the method comprising the steps of:

(a) providing an energized first process gas in the chamber to clean the surfaces in the chamber; and

(b) [adjusting] setting a chamber source power level applied to [an] the antenna [about the chamber to control the amount of] to remove residue from [removed from] the surfaces of the ceiling portion.

45. (amended) A method according to claim [43] 44 wherein the oxygen containing gas consists essentially of oxygen.

47. (twice amended) A method of etching a substrate in a chamber and at least partially removing etchant residue from surfaces in the chamber, the method comprising:

(a) supporting the substrate [comprising] in the chamber, the substrate having a metal silicide containing layer thereon;

(b) providing an energized gas in the chamber to etch through the metal silicide containing layer, the energized gas comprising a fluorinated gas;

(c) after (b), providing an energized gas consisting essentially of O_2 in the chamber to at least partially remove etchant residue from the surfaces in the chamber and to remove residual charge accumulated in the substrate; and

(d) after (c), removing the substrate from the chamber.

51. (twice amended) A method of etching a substrate in a chamber and at least partially removing etchant residue from surfaces in the chamber, the method comprising:

(a) supporting the substrate in the chamber, the substrate having a first and a second layer thereon, the second layer comprising a metal silicide layer;

(b) providing a first energized gas in the chamber to etch the first layer;

(c) providing a second energized gas in the chamber to etch the second layer and at least partially remove the etchant residue formed on the surfaces in the chamber in (b); and

(d) providing an energized cleaning gas to at least partially remove residues formed on surfaces in the chamber in (b) and (c).